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ABSTRACT

The Albuquerque (New Mexico) Public Schools conducted a three-year study of integrated computer-based learning systems, including WICAT, Dolphin, PLATO, CCC, and DEGEM. Through cooperation with the Education Consolidation Improvement Act Chapter 1 program, four large integrated learning systems (ILS) were purchased and studied. They were installed and implemented in 1984. Due to budget constraints, the PLATO program was dropped from the study. The DEGEM system will be evaluated during the second year of the project and is not included here. The primary application of the ILS was to provide Chapter 1 students with supplemental instruction in reading, language arts, and mathematics through computer assisted instruction (CAI). The evaluation compared the four systems' effectiveness. Aspects of the evaluation included the match between ILS, curriculum content, and standardized achievement test content; instructional and technical characteristics; documentation; management systems; diagnostic placement; programming; staffing and training; cost effectiveness; and student and teacher perceptions of value. Results indicated the CAI programs were under-utilized during their first year, largely due to staffing patterns. Mathematics impact was generally greater than reading. The importance of a full-time laboratory operator was repeatedly noted. (GDC)

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CAI: A MODEL FOR THE COMPARISON AND SELECTION OF INTEGRATED LEARNING SYSTEMS IN LARGE SCHOOL DISTRICTS

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INTRODUCTION

School districts are faced with increasingly difficult decisions in the selection of large integrated, computer-based instructional systems based on their curriculum relevance, cost and educational effectiveness. Such decisions are often made based solely on the information provided by venders rather than a careful assessment of the differential capabilities, performance characteristics and educational outcomes of the systems.

This paper describes the approach used by the Albuquerque Public Schools in conducting a three year study to compare, evaluate and select among integrated computer-based learning systems (including WICAT, Dolphin, PLATO, CCC and DEGEM.

PROGRAM OVERVIEW

In 1983, the City of Albuquerque passed a $5,000,000 bond issue designed to provide access to computer education for all children in the Albuquerque Public Schools. The program called for a three-year implementation plan culminating with the addition of at least one 15-microcomputer lab to each of the district's 120 schools.

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At present, all students, K-12, are provided with a knowledge of computer applications, an awareness of the impact of computers on society and basic skills in using the computer as a tool. Additional microcomputers have also been placed in many schools to address special educational needs. The district currently has approximately 3,000 microcomputers in place and in operation for instructional use.

While computer assisted instruction (CAI) is clearly one of the applications addressed by the district's microcomputer program, a more extensive initiative was taken in this area during the 1983-84 school year. Through cooperation with the Chapter 1 program, a comprehensive plan was undertaken to purchase and study four large integrated learning systems (ILS), including PLATO, WICAT, CCC and Dolphin. These systems were selected because they seemed to be the major integrated learning systems on the market at the time. The Chapter 1 program had been using an older version of the CCC program since 1976, so that system was upgraded at the time the other systems were purchased.

The programs were installed in the spring of 1984 and implemented in the fall of 1984. Since Chapter 1 funds were used to purchase the systems, they were placed in Chapter 1 schools with the greatest academic needs, a procedure followed for the allocation of Chapter 1 resources in the district. Due to budget constraints anticipated for 1985-86, it was necessary to discontinue one of the programs after the first year. Because the PLATO program was already limited in size and scope relative to the other three systems, it was decided to drop PLATO from the evaluation study.

Although not assigned to Chapter 1 use, a DEGEM integrated learning system was placed in one school during the spring of 1985. Data for the DEGEM system is not available for this initial

phase of the evaluation study, but will be included in the second year of the project. Table 1 provides a summary of the number of sites and type of system configuration used during the first year of the evaluation study.

The primary intent of the application of ILS to the participating schools is to provide Chapter 1 students with supplemental instruction in reading, language arts and math through computer assisted instruction. Secondarily, the comparative effectiveness of the four systems is being studied in order that the district might be better prepared to make decisions regarding expansion of CAI through integrated learning systems in the future.

ILS EVALUATION STUDY COMPONENTS

The three-year study has been designed to focus on the important instructional, technical and performance characteristics of the ILS packages, the conditions for their effective use and the correlation of system educational content with district curriculum. The following is a summary of the major aspects of integrated learning systems that are incorporated into the three-year study:

1. Educational Content
    a. Match between ILS and district curriculum structure and content;
    b. Match between ILS and standardized test structure and content.

TABLE 1

1984-85 CHAPTER 1 CAI CONFIGURATION

PROGRAM	SCHOOL	EQUIPMENT	SETTING
CCC	A	16 Terminals 16 Headsets 1 Mincomputer 1 Printer 1 Digital Speech System	Lab
	B	16 Terminals 1 Printer	Lab
	C	12 Terminals 1 Printer	Lab
	D	12 Terminals 1 Printer	Lab
	E	8 Terminals 1 Printer	Lab
Dolphin	F	12 Terminals 1 Minicomputer 1 Printer	Lab
	G	12 Terminals 1 Minicomputer 1 Printer	Lab
	H	12 Terminals 1 Minicomputer 1 Printer	Lab
	I	12 Terminals 1 Minicomputer 1 Printer	Lab
WICAT	J	30 Terminals 1 Minicomputer 1 80 megabyte expansion unit 1 Master Terminal 1 Printer	Lab
PLATO	K	7 Microcomputers	Classroom
	L	7 Microcomputers	Classroom
DEGEM	M	32 Terminals	Lab

2. ILS Instructional Characteristics

   a. Instructional range

      1) grade level

      2) ability level

   b. Program Uses

      1) drill or practice

      2) tutorial

      3) simulation

      4) instructional gaming

      5) problem solving

      6) informational

      7) tool use (word processing, spreadsheet, etc.)

      8) teacher utilities

   c. Lesson length (average time)

3. Documentation/Resource Materials

4. Management, Record Keeping and Reporting Systems

5. Diagnostic Placement/Evaluation

   1) diagnostic placement in appropriate program module or lesson

   2) pre and post testing

6. Programming Capability

7. Authoring System

8. Micro Capability

9. Technical Characteristics

   a. use of graphics

   b. use of color

   c. use of audio

   d. use of animation

   e. student interface

   f. variable timing/rate of presentation

   g. effective personalization

   h. random generation

   i. user control

   j. early exit

   k. add or change content

   l. feedback

10. Staffing Requirements

11. Training

   a. operator/teacher training requirements

   b. training assistance provided by vendor

12. Hardware/Software Maintenance and Service

13. Contract and Warranty Terms and Conditions

14. Cost Considerations

    a. lease/purchase

    b. operational expenses (operator, supplies, telephone, etc.)

15. Educational Value and Impact

    a. pre-test/post-test comparisons

    b. standardized test measures

    c. gains per hour of use

16. Student Perceptions of Value of Program

17. Teacher Perceptions of Value of Program

GENERAL CHARACTERISTICS OF INTEGRATED LEARNING SYSTEMS

An integrated learning system is typically defined as a completely computerized education package in which the hardware and courseware components are intended for exclusive use with one another (Dudley, 1983). All of the systems included in the APS evaluation study were originally based on powerful minicomputers or mainframes. Although, almost all of the companies now also provide versions of their courseware for use with microcomputers, they indicate continued growth in the use of their ILS packages by the schools.

All of the firms offering ILS packages have supported an expensive and long-term R&D effort in producing the systems. The following tables provide a summary of the major technical features (Table 2) and the instructional aspects (Table 3) of the five systems that were or are presently included in the APS evaluation study.

EVALUATION DESIGN

The first year evaluation plan had four components:

1) analyze pre-post achievement test data in relation to amount of time on CAI;
2) survey classroom teachers pertaining to the effectiveness of CAI as a tool to support regular classroom instruction;
3) determine the correlation (not statistical) between the district's reading and math curricula and the instructional content of teach of the integrated learning systems and
4) review, compare and contrast the management systems of the WICAT, CCC, and Dolphin packages.

IMPACT DATA

With only a few exceptions, the CAI programs were under-utilized in 1984-85, largely due to inconsistent staffing patterns across the three programs. The original implementation plan called for Chapter 1 to provide the hardware and courseware for each lab and for the district to provide lab supervision, mostly in the form of the regular classroom teacher accompanying students to the lab. Each school was responsible for arranging for lab supervision. While there was a plan for supervision and a student schedule for each lab, the press of other matters often precluded lab attendance.

TABLE 2

5 CAI SYSTEMS OPERATING IN APS IN MAY, 1985*

TECHNICAL MATRIX

	CCC	DEGEM	DOLPHIN	PLATO	WICAT
1. Hardware	Integrated learning system CCC 17 Miniocomputer	Integrated learning system PDP 1123 Mini-computer	Integrated learning system Modified Digital Mini-computer	Control Data CDC Micro-computer	Integrated learning system 300 WICAT Minicomputer
2. Maximum No. of Terminals	96	32	12	Single stand alone units	30
3. Special Features	Audio output & headphones (optional)	Includes touch keys Full type-writer key-board (optional)		Touch sensit-tive screen	Audio output and headphones (opt.)
4. Maximum No. of Student Records	5000	1500 per school with a 5 school max.	1000	Each teacher stores his/her classes only	Several thousand
5. Utilization of Computer Capability	Minimum amount of graphics Black & White display	Graphics on certain programs. Black & White display	Minimum amount of graphics Black & White	Graphics vary by program Animation Green & Black display	Scores reinforce-ment, and some instruction, pre-sented in graphic form. Green & black display
6. Programming Capability	Present CCC 17 has BASIC available. New Micro-host has UNIX for word pro-cessing, pro-gramming/ electronic mail & file transfer	Options include RSTS/E System		Built-in TI BASIC	Available language support: APL, assembler BASIC, COBOL, FORTRAN 77 and PASCAL
7. Authoring System	No	Available	Available	No	WISE Authoring System available

*From CAI SYSTEMS, Report of Computer Assisted Instruction Project, College of Education, University of New Mexico.

In addition to attendance problems, a review of the time-on-task information collected indicated that for many students the systems were inappropriqately used, the result being that the students failed to experience the curriculum as it was designed. System reports indicated that students would exit one lesson prior to completing it, begin a second lesson and do the same thing again , all within the 15-20 minute session. This, of course, interrupted any continuity and reinforcing aspects of the curriculum. Consequently, many students were enrolled in the CAI program anywhere from 25-30 weeks, but accumulated relatively little constructive time-on-task. Both the attendance difficulty and the inappropriate use of the systems clearly stem from the structure of the lab supervision. Where there was stable supervision, problems were less evident. Table 4 reflects average hours of CAI time-on-task in supervised (1 FTE or .5 FTE lab operator) and unsupervised labs in both reading and math. Means were calculated on students with 5 or more hours of CAI service.

At best, implementation and operation of the CAI programs were inconsistent in the case of some of the CCC and Dolphin labs. This fact makes it difficult to interpret the available achievement impact data. Since the service problems were not related to the CAI systems, no comparisions of program effectiveness can legitimately be made. Several overview statements can be made in the cases where sufficient service was provided, however:

1) math impact was consistently greater than reading
2) considerably more time-on-task was provided where there was a full-time lab operator
3) considerably more students were served where there was a full-time lab operator

CAI/CURRICULUM MATCH

A primary concern in the selection of an integrated learning system is the extent to which a district's curriculum matches the CAI curriculum in the areas to be covered. While this study

TABLE 4

NUMBER OF STUDENTS SERVED AND AVERAGE HOURS OF CAI TIME-ON-TASK

School	Program	Number Served Math	Average Hours Math	Number Served Reading	Average Hours Reading
SUPERVISED LABS					
F	Dolphin	95	32	70	36
G	Dolphin	160	31	104	12
H	Dolphin	1	29	64	15
I	Dolphin	0	0	90	NA*
J	WICAT	166	24	84	21
E	CCC (.5 FTE)	37	17	31	9
UNSUPERVISED LABS					
C	CCC	9	6	0	0
B	CCC	38	10	26	11
A	CCC	48	8	16	9
D	CCC	34	10	2	5

* NO HOURLY DATA COLLECTED AT SCHOOL "I" DUE TO LATE START.

was not done prior to implementation, the results are still proving useful. Three classroom teachers and three Chapter 1 reading teachers were asked to compare the district's reading and math instructional objectives with the three CAI systems to be continued into the 1985-86 school year - Dolphin, WICAT and CCC. Each reviewer had considerable experience with the particular CAI systems and the subject area they were studying.

Only the elementary portions (K-5) of the CAI curricula were studied. Comparisons were made in the areas of math and math problem solving, reading and reading comprehension.

As shown on Tables 5 and 6, each program had its own strengths in the comparisons:

1) WICAT compared most favorably to the district's curriculum in math, covering about 54% of the instructional objectives across grades 1-5.
2) Dolphin compared most favorably in reading, covering almost 80% of the district's reading objectives at grades 3-5 (both CCC and WICAT offer reading curriculum at grades K-2, but that comparison has not been completed).
3) WICAT compared most favorably to the district's reading comprehension program across grades 3-5 by covering 90% of the instructional objectives (CCC and Dolphin also compared favorably, covering 82% and 77% of the objectives, respectively).
4) CCC provided a more consistent match in each area by grade level, although wide variations in the match from one grade to another were noted in all systems.

However, the results across all three systems and subject areas (reading, math and reading comprehension) were very similar across grade levels: Dolphin, 67% match; WICAT, 63%; and CCC, 63% match. It is not clear that these comparisons are either good or bad. Additional impact data will be necessary in order to make that judgment.

TABLE 5

ILS CURRICULUM AND APS CURRICULUM MATCH BY LEVEL

MATH

	DOLPHIN	WICAT	CCC
LEVEL 1	27%	47%	33%
2	25%	38%	38%
3	50%	50%	39%
4	63%	63%	50%
5	54%	71%	57%
ALL	44%	54%	43%

TABLE 6

ILS CURRICULUM AND APS CURRICULUM MATCH BY LEVEL

COMPREHENSION

		DOLPHIN	WICAT	CCC
LEVEL	K		25%	
	1		100%	
	2		80%	50%
	3	67%	92%	75%
	4	85%	92%	92%
	5	80%	87%	81%
	ALL	77%	79%	75%

CAI/ACHIEVEMENT TEST MATCH

A similar analysis is being performed between the content of the ILS and the major evaluation instrument used by the district. Tables 7 and 8 are two examples of the analysis tables comparing content of the CTBS with the ILS curriculum. At present, the analysis has only been completed for two grade levels.

MANAGEMENT COMPONENTS

Another issue of major significance in the selection of an integrated learning system is the type of management system available with the CAI program. To a large extent, the manner in which a school or district elects to staff its CAI program will determine whether the management system will be effective.

The CCC management system appears to be the only one that permits a CAI lab to operate without a full-time lab operator. Even with this capability, the CCC program functions much more effectively with a lab operator. WICAT and Dolphin definitely need to have lab operators to run their programs.

All three programs have initial placement procedures that facilitate implementation for students. CCC and WICAT placement procedures are more automated than Dolphin's. In addition, progress through the curriculum is largely automatic (machine driven) with WICAT and CCC, while Dolphin requires ongoing manual input to keep a student moving through a curriculum area.

TABLE 7

ILS CURRICULUM & CTBS MATH COMPUTATION CONTENT MATCH - GRADE 4

	CTBS	DOLPHIN	CCC	VICAT
ADD WHOLE NUMBERS	6	X	X	X
ADD DECIMALS OR FRACTIONS	4	X	X	X
SUBTRACT WHOLE NUMBERS	6	X	X	X
SUBTRACT DECIMALS OR FRACTIONS	4	X	X	X
MULTIPLY WHOLE NUMBERS	8	X	X	X
DIVIDE WHOLE NUMBERS	9	X	X	X
MATH CONCEPTS				
NUMERATION	10		X	
NUMBER SENTENCE	7		X	
NUMBER THEORY	6		X	
PROBLEM SOLVING	9	X	X	
MEASUREMENT	9	X	X	X
GEOMETRY	4	X		X

TABLE 8

ILS CURRICULUM & CTBS LANGUAGE ARTS CONTENT MATCH - GRADE 4

	CTBS	DOLPHIN	CCC	WICAT
CAP OF PRONOUN I NOUNS & ADJECTIVES	6	X	X	X
CAP OF BEGINNING WORDS & TITLES	4	X	X	X
USE OF PUNCTUATION MARKS	8	X	X	X
PUNCTUATION & CAPITALIZATION/EDIT	6		X	X
NOUN USAGE	4	X	X	
PRONOUN USAGE	4	X	X	X
VERB USAGE	5	X	X	X
ADJECTIVE/ADVERB USAGE	4	X	X	
SENTENCE PATTERNS				
SENTENCE FORMATION	4		X	
SENTENCE RECOGNITION	4	X	X	
SENTENCE COMBINING	10			
TOPIC SENTENCE	5	X		
SEQUENCE	5	X		
USE OF QUOTATION MARKS	4	X	X	

However, with a full-time lab operator, placement and progress issues do not have to be stumbling blocks with any of the programs.

There are more similarities than differences among the three programs in the areas of setting up classes, enrolling students and changing or adding courses or assignments. Again, a full-time lab operator ameliorates problems associated with these activities under a structure of less supervision.

Student progress reports are the link between CAI and the classroom instruction it supports. While all three CAI systems have extensive reporting procedures, the reports may not be equal in their useability and readability. Reports were not used consistently with any of the programs in 1984-85, so data regarding their appropriateness are not available. The overall CAI configuration of 1985-86 will allow for extensive use of the student and class reports and their appropriateness will be carefully studied.

The CAI report features considered important at this point are:

1) indications of student growth or progress in a form or metric familiar to teachers;
2) relative relative strengths and weaknesses in the subject areas in which the students are enrolled, and
3) progress in terms of skills mastered.

With these data, classroom teachers can optimize the impact of CAI on participating students.

CLASSROOM TEACHER ASSESSMENT

In addition to traditional impact data such as achievement test scores, a large number of teachers (75) in the CAI schools were asked to assess the effects of their respective CAI systems on their students. In general, teachers were very positive. They observed that students made more progress in math than in reading. This progress was most often reported as showing up in the students' daily classroom work. Responding teachers did feel that CAI can serve as an important supplement to instruction for Chapter 1 students.

RECOMMENDATIONS

After one year, a great deal has been learned about CAI. Based on the results of the first year evaluation study, the following points were taken into account as the CAI program continued during the second year:

* To guarantee maximum usage of the systems, consideration should be given to funding an operator for each lab;

* To facilitate meaningful communication, utilization and integration throughout the year, classroom teachers should continue to be included in training in the curricular content of the systems;

* To assure appropriate expansion and integration, the study of CAI management components and cirricula content should continue, and

* To insure proper interpretation of 1985-86 impact data, the content match between the achievement test (CTBS) administered at Chapter 1 schools and the curricula of each of the three integrated learning systems (CCC, WICAT, Dolphin) in use should be completed during the second phase of the study.

Based on the results of the first year of the evaluation study, it is clear that a number of conditions must be established in order to make a more realistic and comprehensive assessment of the relative advantages of the different ILS packages for continued implementation in the district. During the second year of the study (currently in progress) such conditions have been established and data will be obtained for the data categories identified in the model.

REFERENCES

DUDLEY, A (1983) ***INTEGRATED LEARNING SYSTEMS***, ELECTRONIC LEARNING, 5,72-76